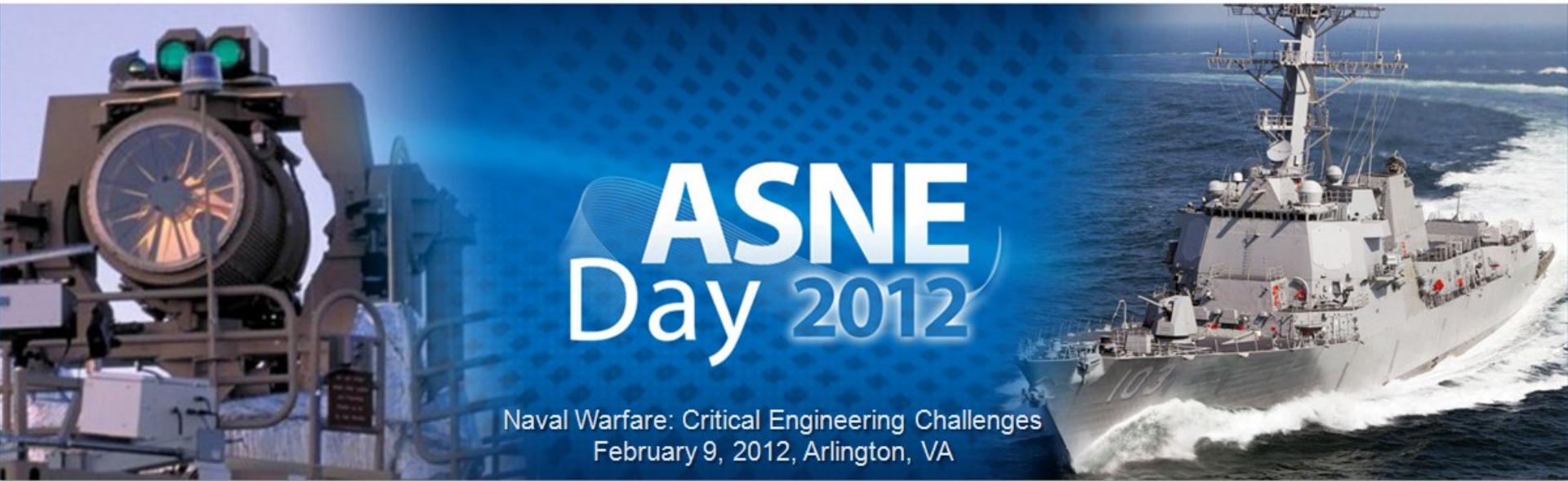


# Hull, Mechanical, & Electrical (HM&E) Roadmap: Revolutionizing Naval Warfare and Achieving Energy Security



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# Honorable Ray Mabus 75<sup>th</sup> United States Secretary of the Navy

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**"OUR SHIPS - THE SYSTEMS THAT WE USE AND THE POWER REQUIREMENTS THAT THEY HAVE ARE GETTING BIGGER ALL THE TIME. EVERY SYSTEM WE'RE PUTTING ON A SHIP NOW OR IN AN AIRCRAFT IS IN SOME WAYS SORT OF A POWER HOG... WE HAVE TO FIND A DIFFERENT WAY TO POWER THE THINGS WE NEED TO POWER."**

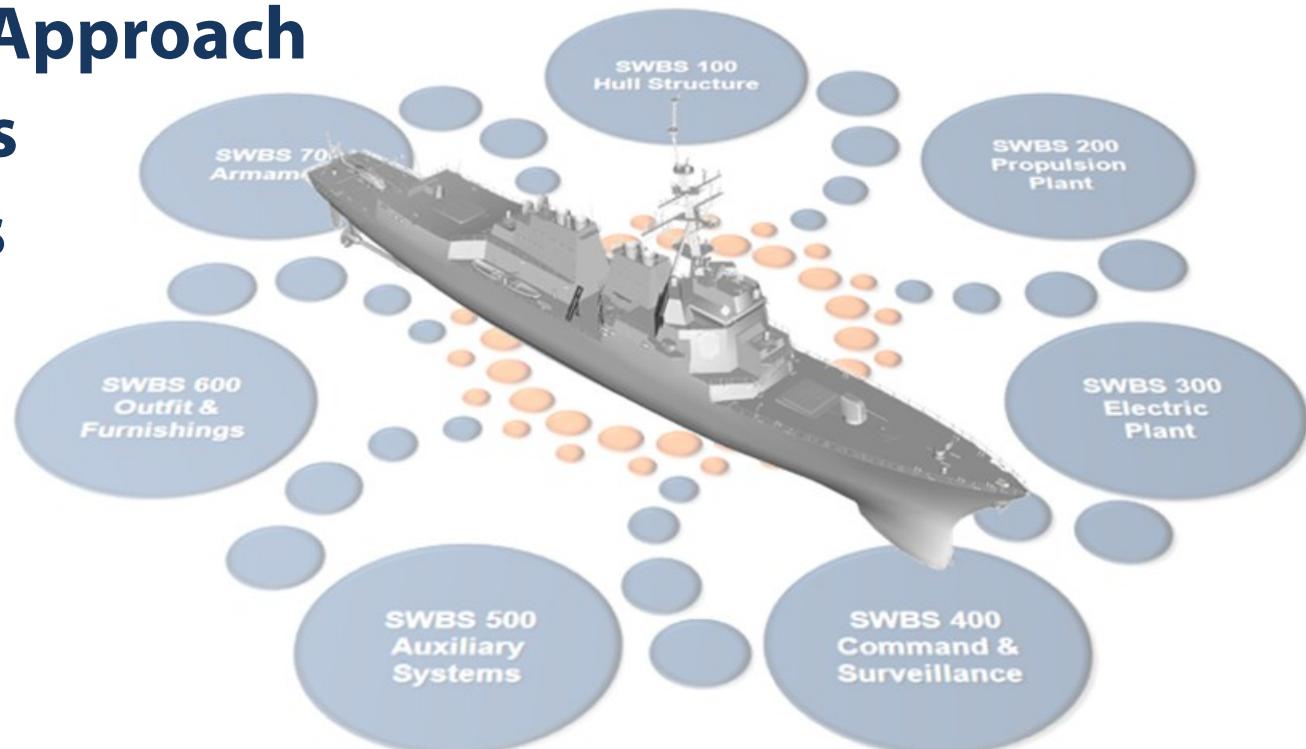
ARPA-E  
ENERGY INNOVATION  
SUMMIT

***Fundamental Shift Required for In-Service and New Construction Programs***

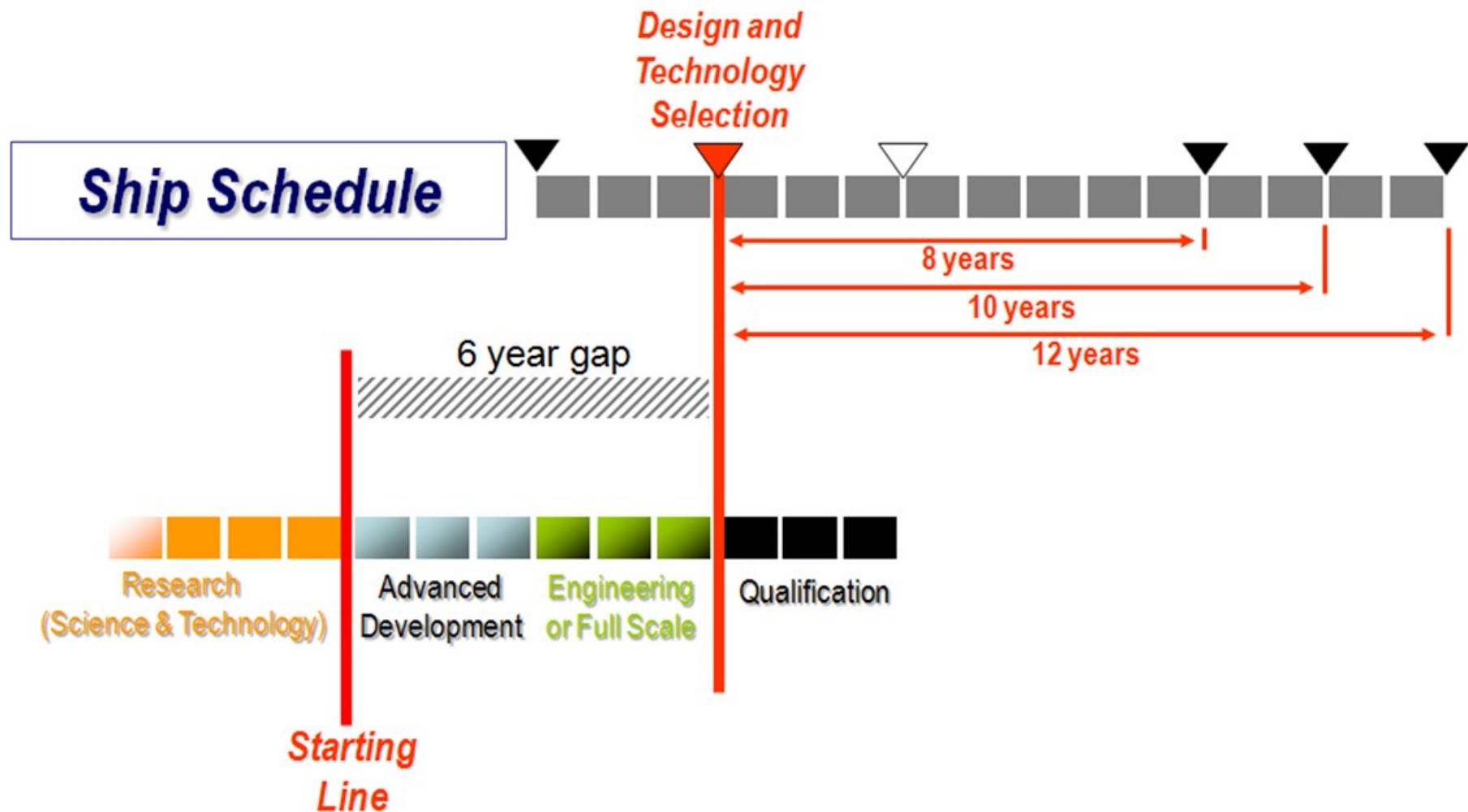
# HM&E Roadmap: Revolutionizing Naval Warfare and Achieving Energy Security

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- **Background**
- **Objective**
- **Purpose of Roadmap**
- **Proposed Approach**
- **Challenges**
- **Next Steps**

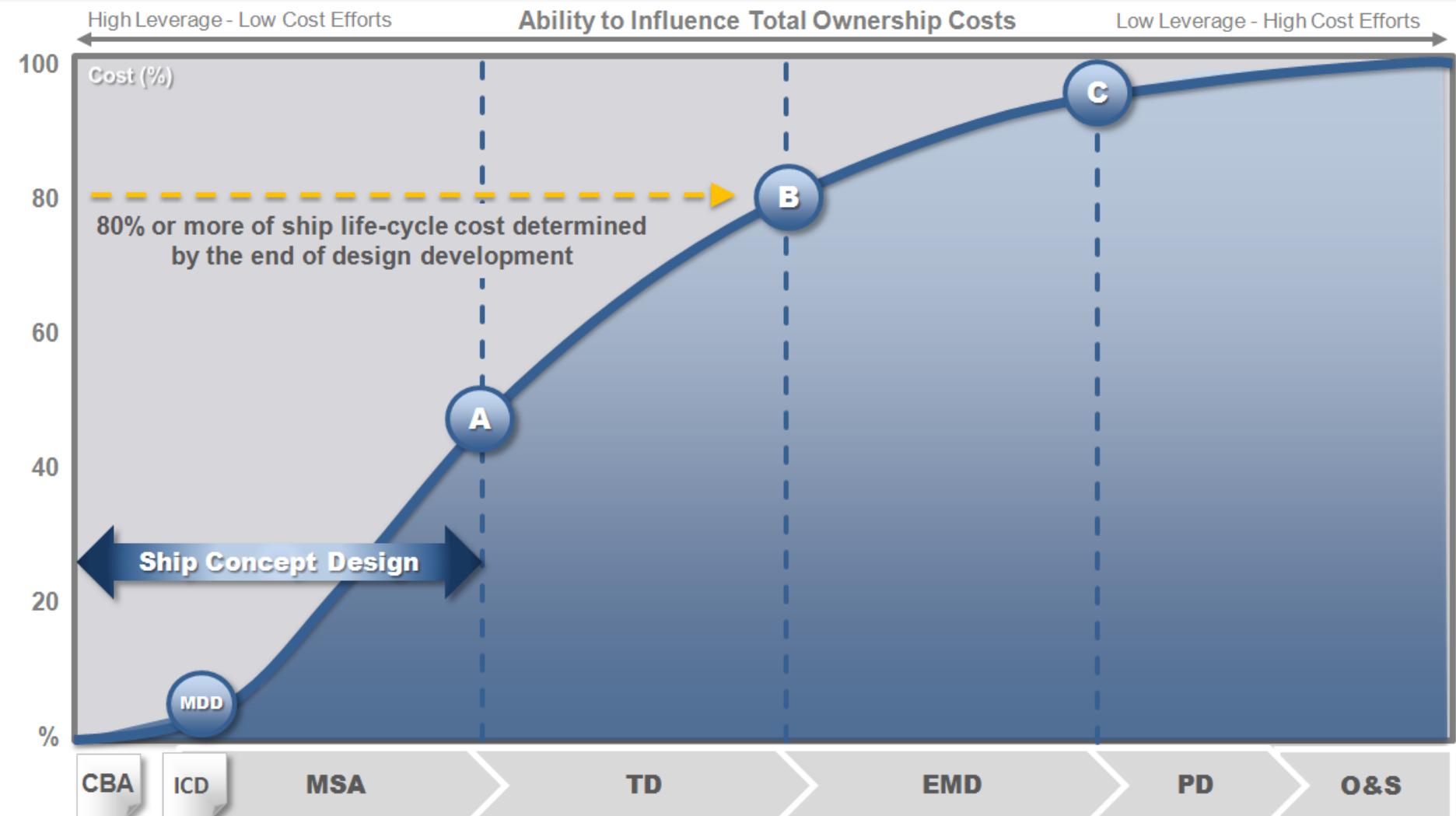


# Background: Notional Timeline



# Background: Ability to Influence Total Ownership Costs

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*Greatest ability to influence with lowest cost impact is during pre-Concept Design*

**Develop a technology plan that is responsive to future threats & weapons capabilities, shipbuilding plans & schedules, current fleet opportunities, and budgetary realities**

Provides sufficient data to inform budget decisions for S&T, R&D, new acquisition/construction, and fleet insertion

**Provides a means of expressing HM&E needs and opportunities to resource sponsors, S&T/R&D organizations, ship/warfare systems program managers, and fleet activities**

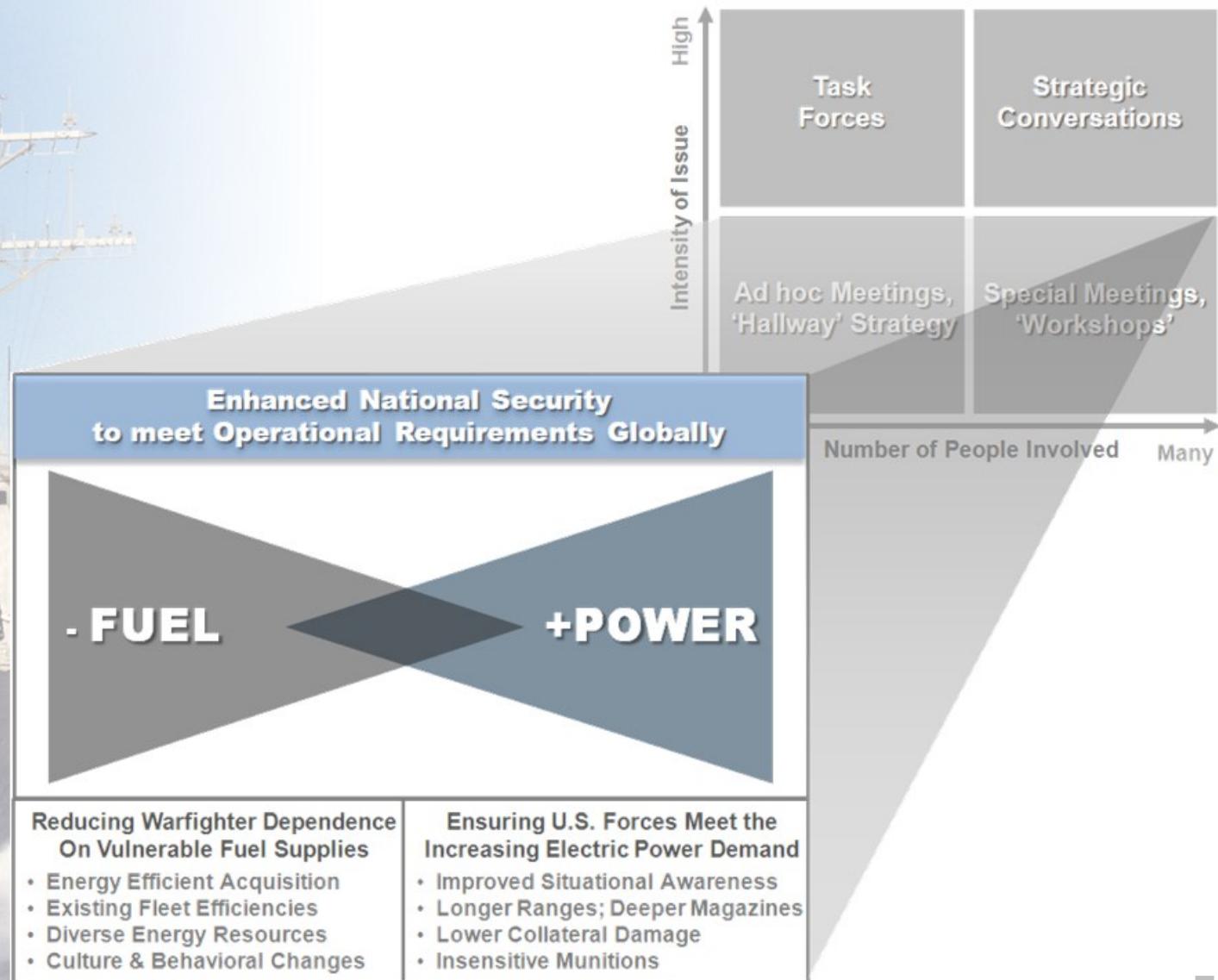
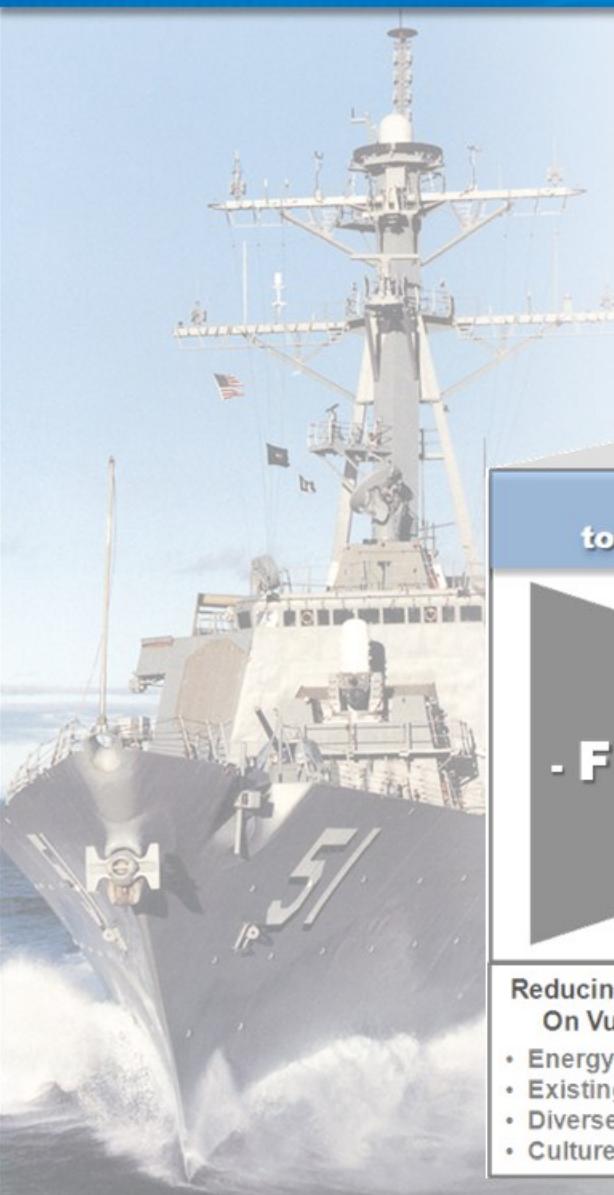
Resolves competing frameworks (future warfare requirements, life cycle costs, etc.) that foster short-term stovepipe approaches rather than long-term sustainable solutions

Serves as unifying document between organizations to address future challenges in full alignment

Provides a foundation for Industry and Government agencies to focus their resources

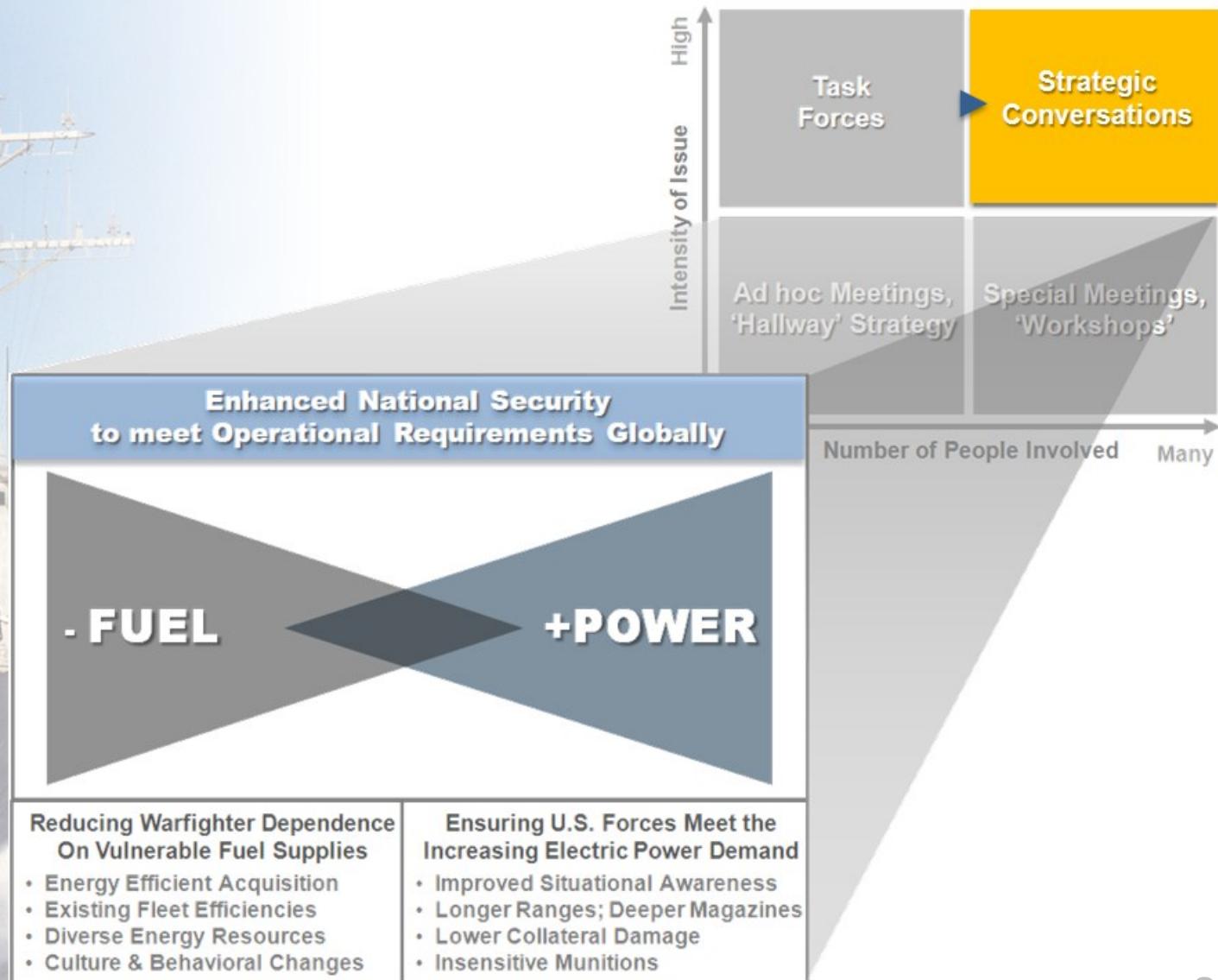
# Purpose: Energy As A Strategic Resource

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# Purpose: Energy As A Strategic Resource

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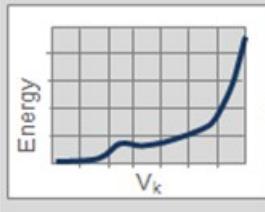
# Approach: Identifying the Gap

## Total Life-Cycle Energy Requirement

### Overarching Design Reference Mission

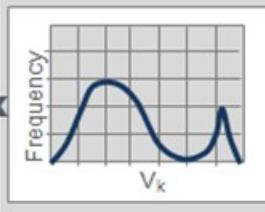
#### Propulsion Energy

(Ship Type Energy  
vs. Speed)



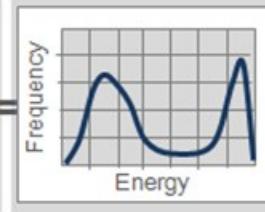
#### Operational Profile

(Ship Type  $V_k$  vs.  
Frequency at Mission)



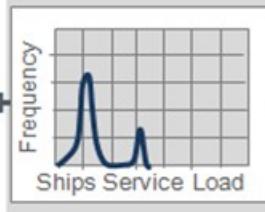
#### Propulsion Energy

(Ship Type Energy vs.  
Frequency at Mission)



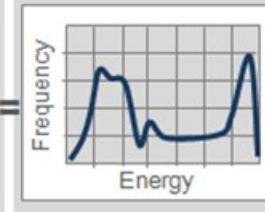
#### Ship Service Energy Load

(Ship Type Energy vs.  
Frequency at Mission)



#### Ship Total Energy Load

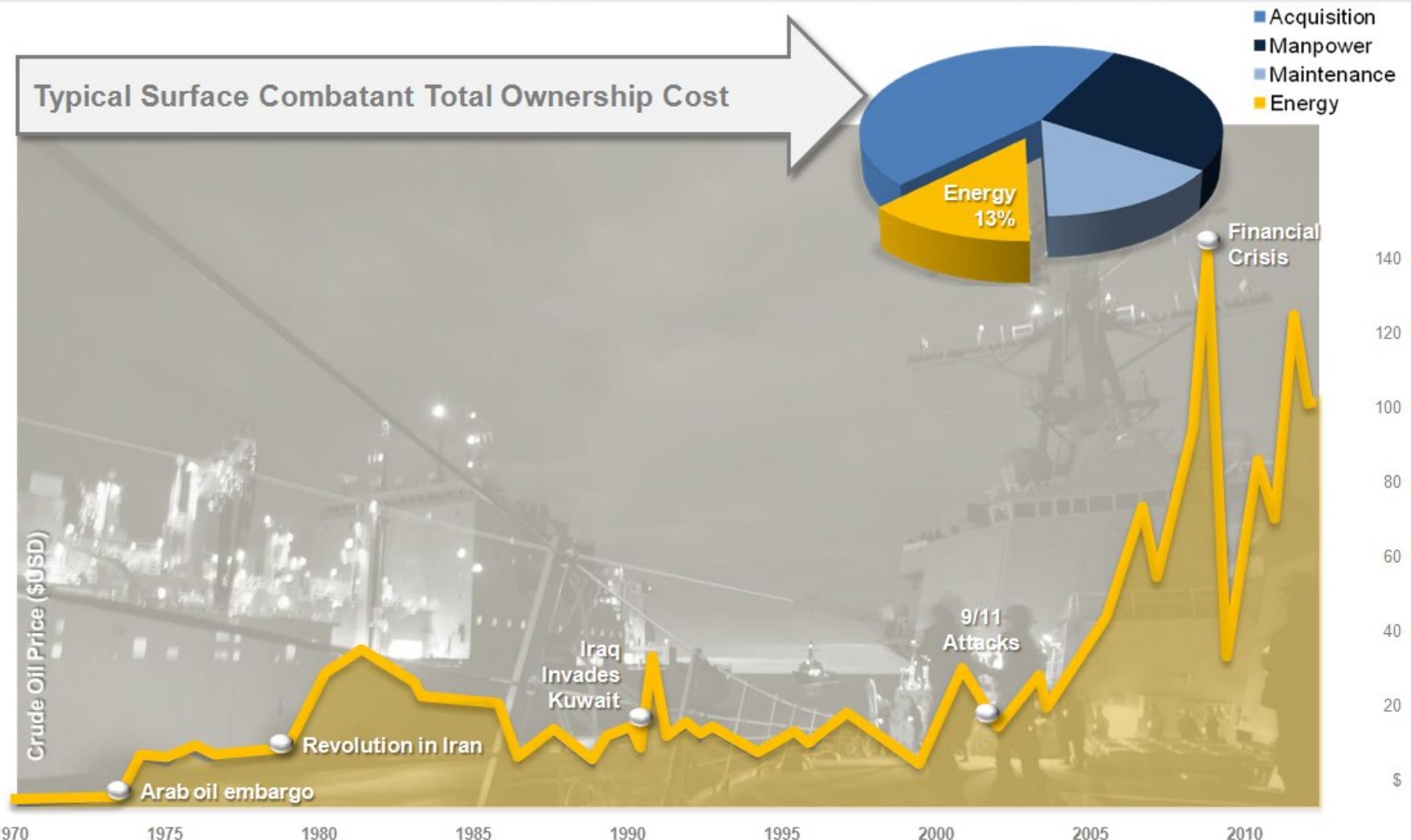
(Ship Type Total Energy  
vs. Frequency at Mission)



Mission Profile, Operational Tempo, & Expected Service Life

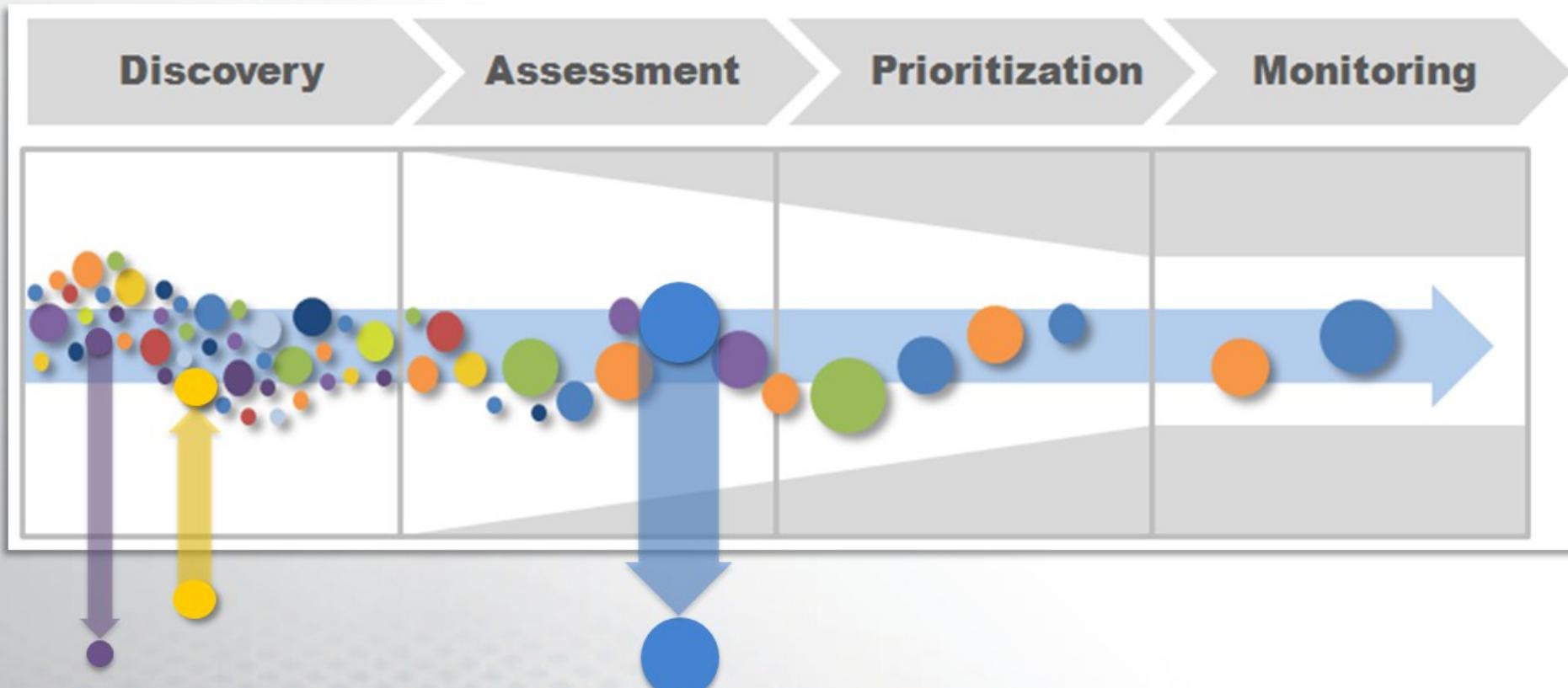
# Approach: Identifying the Gap

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# Approach: Balanced Technology Portfolio

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*Maritime Energy Portfolio Process*

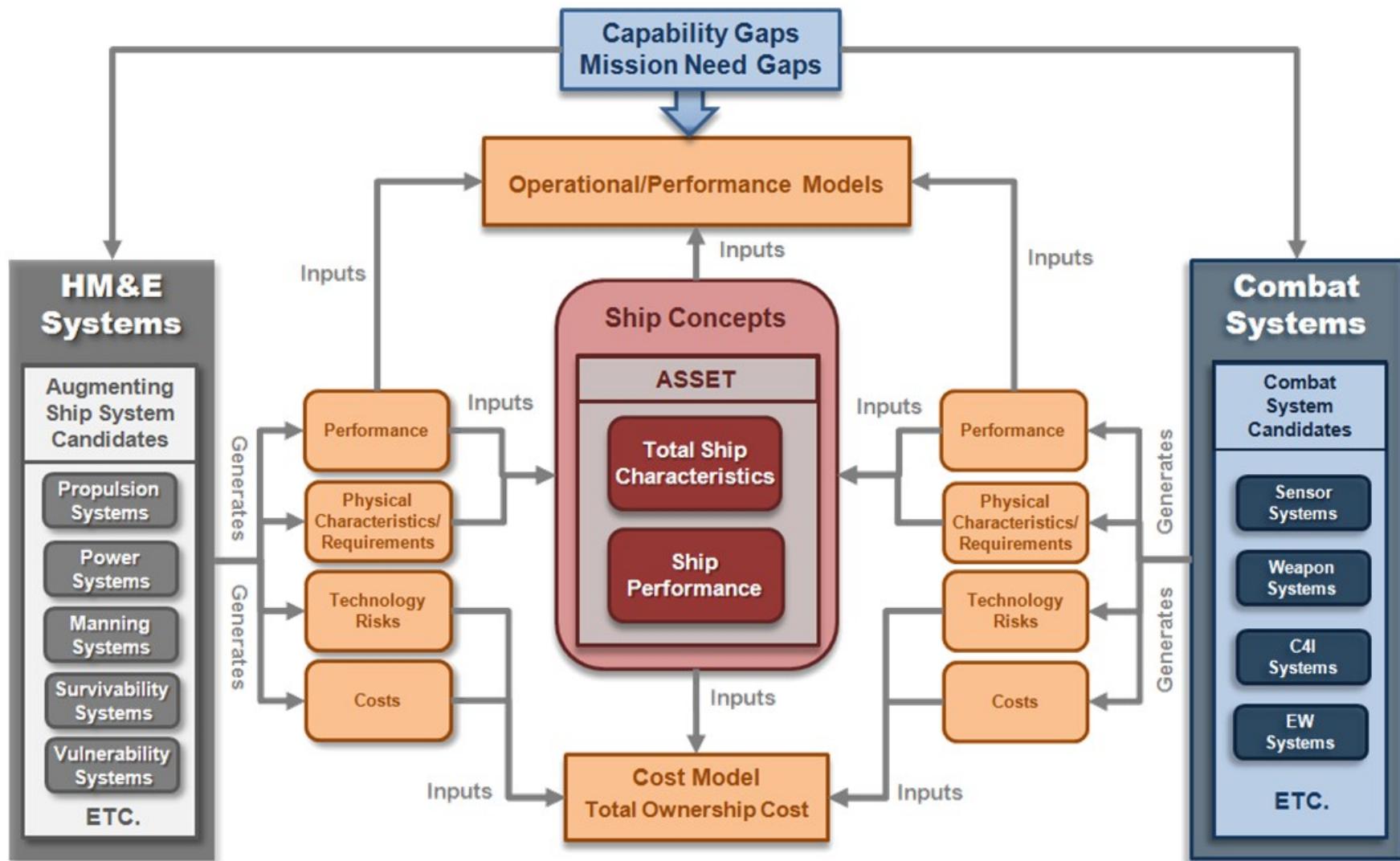
**Define a portfolio of concept alternatives that fulfill current and future mission and capability gaps, meet the needs, requirements, and acquisition cost goals**

**Establish traceable linkages and direct relationships between mission effectiveness/performance associated with individual ship concepts, technology risks, acquisition cost, and total ownership cost**

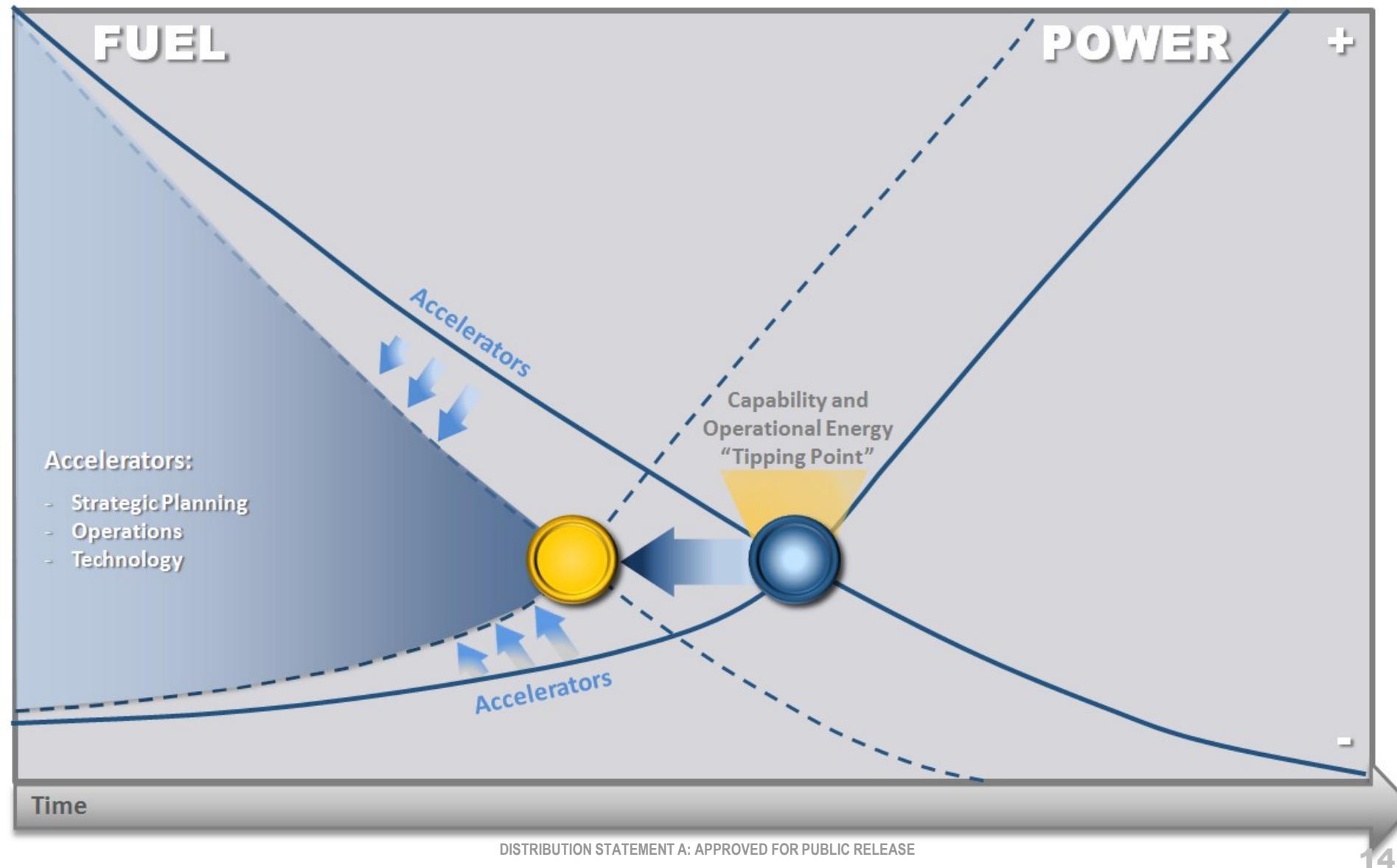
*“...resource management decisions on future investment alternatives should focus on capability-based requirements assessed through a cost benefit analysis structure.” OPNAV Ser 814/638503, 03 Dec 2003*

# HM&E Roadmap Approach: Capability Based Concept Development

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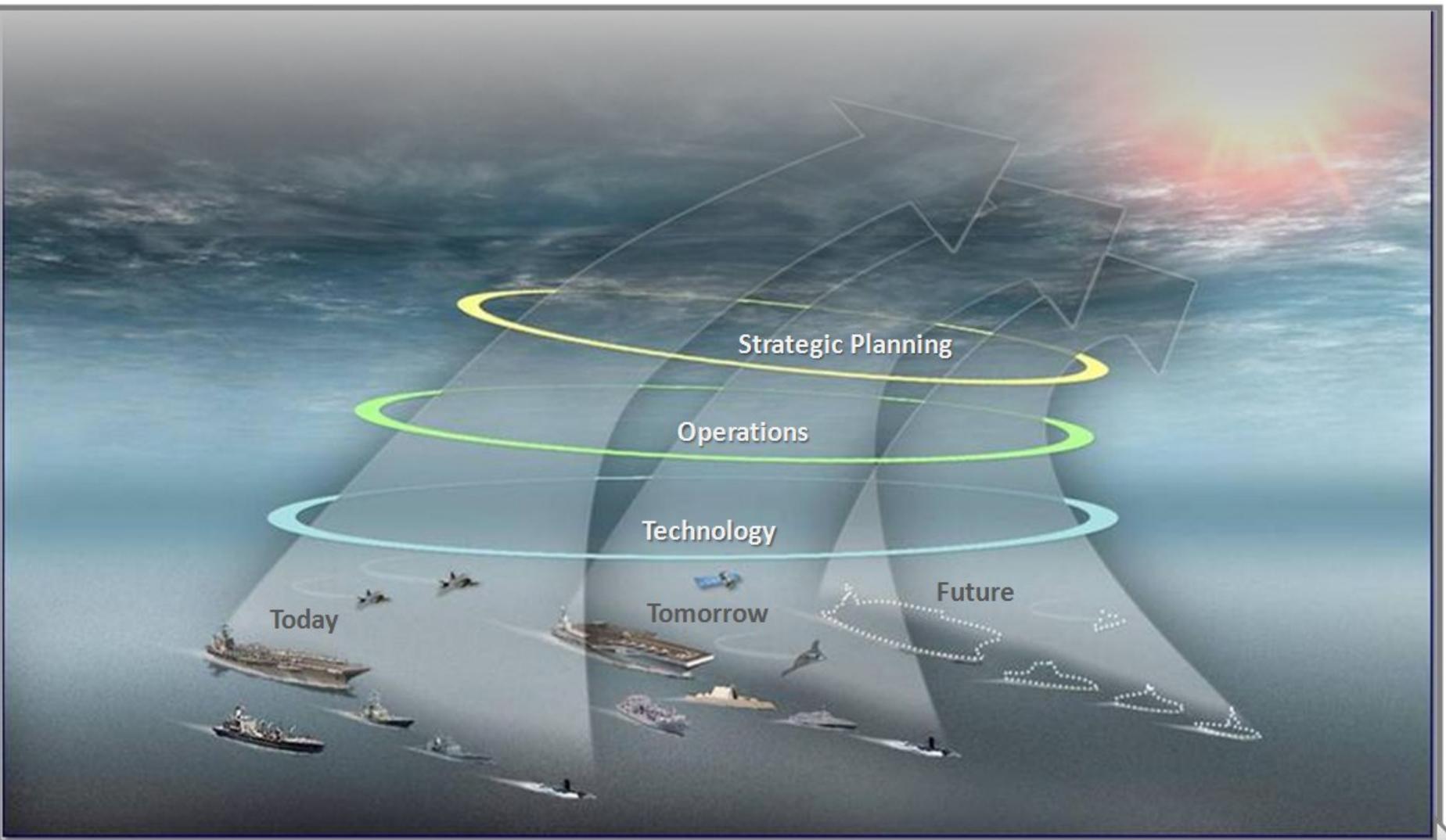


# Approach: Accelerating the Transformation



# Approach: Moving Toward an Energy Secure Fleet

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## HM&E Roadmap... what it means

- Communicating the Vision from top to bottom
- Integrating S&T focus with shipbuilding plans
- Identifying gaps and focus areas
- Identifying areas of synergy for common investment
- Linkages to program needs and milestones
- Leverage enterprise-wide partnerships
- Sharing knowledge across teams

